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Geomorphology: Perspectives on observation, history, and the field tradition

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ABSTRACT

Other than a common interest in form and process, current geomorphologists have little in common with those who established the foundations of this science. Educated people who had an interest in Earth processes during the nineteenth century cannot be compared to the scholars who study geomorphology in the twenty-first century. Whereas Earth has undergone natural change from the beginning of time, the human record of observing and recording processes and changes in the surface Is but a recent phenomena. Observation is the only thread, however, that connects all practitioners of geomorphology through time. As people acquired knowledge related to all aspects of life, technological revolutions, such as the Iron Age, Bronze Age, agricultural revolution, the atomic age, and the digital age, shaped human existence and thought. Technology has greatly changed the power of human observation, including inward to the atomic scale and outward into the realm of space.

Books and articles describe how to collect and analyze data but few references document the field experience. Each of us, however, has experienced unique circumstances during field work and we learned from various mentors how to observe. The surface of Earth on which we practice the vocation of geomorphology may not be much different from a hundred years ago but many things about how we collect data, analyze it and disseminate the results have changed. How we function in the field, including what we wear, what we eat, how we get there, and where we choose to collect data, clearly reflects the complexity of the human system on Earth and the processes and forms that arouse our interest. Computers, miniaturization of electronics, satellite communications and observation platforms in space provide access to data to aid in our quest to understand Earth surface processes. Once, people lived closer to nature in primitive shelters in contrast with life in urban environments. But as urban life continues to expand and people need to know how Earth operates, geomorphologists, therefore, serve humanity today as the primary observers and reporters in the realm of Earth surface processes.

1. Introduction

The field tradition in geomorphology began long before the field of geomorphology or the term geomorphology was coined to describe the study of Earth surface processes. Before writing appeared, humans were observing nature and passing stories of extreme geomorphic events, such as floods and mass movements, to future generations. Survival depended, in part, upon living in harmony with nature and being lucky to be out of the way of catastrophic events, which required careful observation about how changes in the local environment could impact daily life. Living beside a stream could provide water on a daily basis, but changes in stream discharge would fluctuate with precipitation, possibly becoming a hazardous flood. The knowledge people acquired about the environment contributed to their decisions, which helped with survival and migration (Carter, 1980). Elders of the tribe were valued because they survived the longest and had the most experiences to pass on to the next generation.

In time, elders became scholars and generalists emerged who reflected on all aspects of the environment in the 19th century. Subsequently, scholars acquired narrow focuses on particular topics, such as rivers, glaciers, sand dunes, coastal environments, slopes, mountains or applied aspects of geomorphology. The great surge in people earning college educations after WWII contributed to the diversity of sub-disciplines that evolved. Vitek and Ritter (1989, 1993) diagramed the growth of paradigms in geomorphology, which revealed the complexity of sub-disciplines that evolved after WWII. Going back further in time, Orme (2002) illustrated the rise and fall of selected concepts in geomorphology from 1700 to 2000. And, the development of subdivisions with geomorphology continues as new technology is employed to study Earth surface processes.

The purpose of this paper is to reflect on the field tradition in geomorphology, specifically looking from the past, making observations about the present, and positing about the future. Knowledge of how the natural systems of Earth worked was acquired and used to promote survival. Movement into cities, however, changed how people interacted with the natural environment. How to survive in an urban environment requires different skill sets as compared, for example, to living off the land in the outback of Australia. The risk of survival a

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person experiences is not uniform across Earth because the density of population varies from place to place, as do extreme natural events. Through education, people have learned and continue to refine the knowledge necessary to address geomorphic processes in conjunction with living on Earth.

2. Observation

Observation was the key to survival — specifically seeing and interpreting events in nature. Sight is a key human sense, but it is only part of the system for success. As humans moved from place to place, they encountered different landscapes, different weather and climate, and different vegetation. Obviously, they learned to adapt to the conditions that they encountered, because some survived (Carter, 1980). As hunting and gathering were replaced by sedentary life styles associated with the advent of agriculture, people needed more knowledge about how the weather and climate impacted plants. A primary question was — when to plant a crop? Careful observations led different cultures around the world to note that daily life was related to energy from the sun, often considered to be a god in some cultures. The sun appeared to migrate north and south on a regular basis. Calendars were devised to record where the sun was in this migration cycle. Native Americans, for example, developed petroglyphs (Fig. 1) that recorded solstice and equinox events (Zoll, 2008). When to plant, therefore, was tied to the location of the sun in its migratory cycle and the subsequent weather that would normally accompany that position. How long it took people to figure out the cycle and the best way to represent this knowledge is unknown. But clearly, knowledge was acquired through diligent and repetitive observation and displayed for everyone to see and use. Without written records to explain what the symbols meant, however, the real meaning of such displays was lost once the site was abandoned and no longer used as a calendar.

Similar observations about forces in nature from other cultures helped people survive. People used caves for shelter from weather and animals. Most caves are structurally sound, easy to protect, and maintain a relatively stable temperature once away from the main entrance.

Fig. 1. Petroglyphs on the V-Bar–V Heritage site SE of Sedona, AZ. K. Zoll (2008) proved that sunlight struck certain figures only on the solstices and others on equinoxes to demonstrate that the rock was simply not graffiti, as reported by archeologists who had previously studied the site. This image is only a portion of the wall on which petroglyphs were carved. Zoll made a concerted effort to observe and photograph the site on days when the sun was at particular points in its orbit. He interpreted the site after others said it meant nothing. In addition, through continued careful field research he has found ten additional solar calendars throughout the region. His research proves that careful observations can have meaningful results. Ken Zoll was a Chief Information Technology Officer in the Federal Government with no training in archeology when he began this project after retiring to Sedona, AZ. Four publications have been generated by his research efforts.

Archeologists have discovered caves in which people resided for millennia, based upon the stratigraphic record preserved in the cave floor (Svoboda, 2000). A stable living environment eliminated another variable from the quest for survival. Yet, people moved around the world in search of a "better" place, better perhaps for ease in securing food, for protection and ultimately survival. Observation and interpretation of the environment were never taken for granted, as long as people lived in close daily contact with nature. This situation persisted until the domestication of plants and animals. With the advent of domesticated agriculture, people became place bound.

2.1. Fast forward to the past two centuries

People moved from rural areas to cities and became more sedentary because agricultural production flourished and allowed people to specialize in functions not associated with food production. Settlements were established at locations best for transportation, best for a source of power or best because the site could be protected (Brown, 1948). These decisions about the location of a settlement set up potential conflicts with nature because any site can be subjected to extreme events, events that can wreak havoc on human activity and life. Proximity to a river, for example, was fine for water supplies and transportation during normal river flow, but disastrous when floods occurred. Observations and records began to be kept in earnest because how to live with extreme events became important for safety. Moreover, how to bear the costs associated with economic recovery was a critical factor in moving society ahead. People began to acquire specific skills related to Earth surface processes; the field of geomorphology emerged at this time, from the observational traditions of geology and geography.

Despite the great diversity in interests in processes and forms that has evolved amongst scholars, we retain one common thread that can be traced to the beginning of our science — observation. The importance of observation cannot be overstated to all who seek geomorphic knowledge. Everyone must be made keenly aware of the role observation plays in our science. Perhaps the best statement on observation came from Marsh (1864) who wrote in "Man and Nature: Or Physical Geography as Modified by Human Action" (pp 10):

> "*To the natural philosopher, the descriptive poet, the painter, the sculptor, and indeed every earnest observer, the power most important to cultivate, and at the same time hardest to acquire, is that of seeing what is before him. Sight is a faculty; seeing is an art. The eye is a physical but not a self-acting apparatus and, in general, it sees only what it seeks. Like a mirror, it reflects objects presented to it, but it may be as insensitive as a mirror, and not consciously perceive what it reflects.*"

Clearly, just observing is not sufficient, because meaning and interpretation must be applied to what has been observed. One example involves Alfred Wegener, a Danish meteorologist, who hypothesized that the continents once fit together as a super continent that he named Pangaea (1924). The position of the continents today exists because Pangaea split and the pieces drifted apart. Despite very good fossil evidence, his theory of continental drift was not accepted because he lacked a mechanism to move the continents. Decades would pass before evidence could be found that proved that the continents moved, and led to the theory of plate tectonics (Wilson, 1968).

This paper reflects my perceptions as an alpine geomorphologist on how the field traditions in geomorphology have evolved in response to technology. The revolution in technology, including computers, communications, transportation, field gear, and mapping, facilitates the collection and interpretation of data at hazardous sites, remote sites, in laboratories and/or in backyards. Through generations, we have gone from site access on foot, to the use of horses, trains, automobiles, planes and helicopters and finally to observe Earth from space. Gaining access to the field is the first step to acquire observations. Then,